THIRTY-SECOND ANNUAL REPORT

OF THE

SOUTH CAROLINA EXPERIMENT STATION

OF

Clemson Agricultural College

H. W. BARRE, Director

For the Year Ending June 30, 1919

Clemson College, S. C. December, 1919

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LETTERS OF TRANSMITTAL

Clemson College, S. C., December 1, 1919.

Hon. Alan Johnstone, President Board of Trustees, The Clemson Agricultural College.

Dear Sir:—I beg leave to submit herewith the Thirty-second Annual Report of the South Carolina Agricultural Experiment Station, which in accordance with the law, must be submitter to the Governor on or before February 1, 1920.

Yours very truly,

W. M. RIGGS,

President.

Clemson College, S. C., December 1, 1919.

Hon. Robert A. Cooper, Governor of South Carolina.

Sir:—I have the honor to submit herewith the Thirty-second Annual Report of the South Carolina Agricultural Experiment Station in accordance with the requirements of an Act of Congress, approved March 2, 1887, for the establishment of Agricultural Experiment Stations in connection with the colleges of the several States, organized under the provisions of an Act approved July 2, 1862.

Respectfully submitted,

ALAN JOHNSTONE,

President Board of Trustees.

REPORT OF THE SOUTH CAROLINA EXPERIMENT STATION

Clemson College, S. C., December 1, 1919.

Dr. W. M. Riggs, President,

Clemson College, S. C.

Dear Sir:

I have the honor to submit herewith the Thirty-second Annual Report of the South Carolina Agricultural Experiment Station, for the fiscal year ending June 30, 1919.

The great world war, which was brought to a successful conclusion during the period covered by this report, had a marked influence upon the research activities of all agricultural institutions. During the first part of the period while the war was still in progress, the members of the staff who did not actually enter the army devoted their energies largely to stimulating food production and to other activities which seemed to have an important bearing upon winning the war. After the armistice was signed, the problems of reorganizing our work for permanent agricultural development were undertaken, and with the return of some of our staff from army service and war work, new and fundamental research problems were undertaken.

The increased cost of labor, supplies, and equipment, in fact, everything that is needed in conducting agricultural research, has proved a serious handicap in developing our work to meet the increasing demands that are being made upon us by a constituency which is becoming more appreciative of the value of the work each year. During the war every effort was made to secure the application of every bit of scientific data that seemed to have a bearing on food production and agricultural advancement. This had the effect of using up to a large extent the accumulated data of the research agencies,

and also of emphasizing in the minds of the public the value of the results secured by agricultural experimentation. As a result the extension and teaching agencies, as well as a more appreciative public, are now clamoring for information on many of the fundamental agricultural questions which it seems the duty of the Experiment Station to investigate. We appreciate the urgent need of expanding and developing our work to meet these needs and feel all but helpless when we realize that our hands are tied by the lack of adequate funds for conducting much of the fundamental research for which there is such a crying need.

I am giving below a summary of some of the important results accomplished and the important projects undertaken, as well as a general discussion of some of the activities not covered by the reports of the division chiefs, which are attached hereto and make a part of this report.

AGRONOMY DIVISION

During the year the members of the Agronomy staff have devoted their energies to a careful study of experiments under way and previously conducted by this division, and in initiating a number of new projects. The majority of the old projects have been continued, and, while adverse seasons and shortage of labor have interfered with some of these, satisfactory progress has been made with the majority of the experiments.

Variety tests with field crops conducted at Clemson College and at the Dee Pee Station at Florence continue to show striking results with regard to the yields of different varieties of cotton, corn and small grain. At the main station Alabama Cook produced 1890 pounds of seed cotton while King-Triumph produced only 610 pounds, the difference between the best and the poorest variety amounting to 1280 pounds of seed cotton, worth about $150.00. At the Pee Dee Station the highest yield, 2260 pounds, was made by Wannamaker's Cleveland Big Boll and the lowest yield, 1520 pounds, by Drake's Dixie, the difference being 740 pounds of seed cotton, worth about

$80.00. Tests with corn at the main station and at the Pee Dee Station showed Douthit, Garrick, and Weekly yielded highest for the season, Douthit yielding 36 buhsels at Clemson College and 60 bushels at Florence. Similar tests with wheat were conducted at both stations, and the highest yields were made by Fulcaster, Leap's and Golden Chaff in the order named. Appler oats yielded highest and Fulghum next highest in the tests this season.

The large number of fertilizer tests previously reported have been continued. The comparison of forty different fertilizer combinations applied at the main station to land planted in cotton every year for fourteen years indicates, first, that a complete fertilizer is necessary for best results; second, it is becoming more and more difficult to secure a stand on the plots which have been poorly fertilized; and, third, that diseases are much more prevalent in the plots not fertilized with a well balanced fertilizer. The general comparative fertilizer test at the Pee Dee Station, comprising 180 tenth-acre plots and divided into series for a three-year rotation, and for cotton continuously, has now been in operation for six years, and the valuable data accumulated are being compiled for publication. The fertilizer tests have been continued at the Coast Station, but our drainage system proved inadequate during the exceedingly heavy rains of July and August, and no results were obtained. New and more elaborate experiments have been initiated to further test the comparative value of acid phosphate, Florida soft phosphate, and Tennessee hard rock. Tests have also been undertaken with the different sources of nitrogen and potash. Experiments to test the effect of Trona potash and borax on crops were also started in the field at the Pee Dee Station during the summer, and are being continued in the green houses at Clemson College.

Breeding work has been started with cotton, corn, rye, wheat, and barley with a view of developing superior strains of these crops.

This division has begun work on three research projects of fundamental importance. These are: "A Study of Inheritance in Oats"; "A Study of the Effect of Stirring Soil on the Mois-

ture Content, Oxidation, Nitrification and Crop Yield"; and "An Investigation of the Influence of Variety, Fertilizers, Soils, and Climate upon the Oil Content of Cotton Seed." Satisfactory progress is being made with all of these.

ANIMAL HUSBANDRY DIVISION

The work of this division has been practically at a standstill since the last report was prepared. It has taken us practically a year and a half to find a suitable man to put in charge of the work. With the assistance of Professor W. W. Fitzpatrick, Chief of the Dairy Division, and Mr. C. L. Morgan, Assistant Professor of Animal Husbandry, we have been able to keep the breeding work with horses, cattle, and hogs going, and have conducted tests with hog crops at both of the sub stations. A small herd of grade beef cattle, headed by a registered Angus bull, has been started at the Coast Station. We have also started some grazing experiments with beef cattle on the cut-over pine lands of the Coast Station.

Professor L. V. Starkey, the new chief of this division, has reported for duty since the end of the fiscal year, and we have every reason to believe that under his leadership and direction all lines of animal husbandry work will make substantial progress in the future.

BOTANY DIVISION

This division has continued research work with cotton diseases. The Angular Leaf Spot project was completed with the working out of the sulphuric acid treatment as a satisfactory method of controlling this diesase. A full report of this investigation was published as Bulletin No. 198. Several unfinished phases of the cotton Anthracnose investigation have occupied our time during the past year. The major problem has been a study of the influence of different factors on the vitality of the Anthracnose fungus in cotton seed. We have found that by placing infected seed under a vacuum and reducing the moisture content from 9 per cent to about 2 per cent, the fungus is killed and the germinating power of the

seed not injured. This treatment seems to kill all seed-borne diseases and we are now trying out different schemes for drying, with a view of developing a method that can be used economically on a commercial scale. We have found that the anthracnose fungus lives during the summer in the nectar glands of cotton leaves and goes from there to the young bolls.

Some progress has been made with the study of the bacterial content of milk. This study was undertaken last summer with a view of determining the behavior and development of bacteria during the handling of milk from the time it is milked until it reaches the consumer. We find at the outset that some of our methods of cleaning and sterilizing cans and other containers are at fault. Cans and buckets can be sterilized by inverting each can over a jet of live steam for one minute, but such pieces as can lids and separator parts can be sterilized thoroughly only when placed in a closed vat and exposed to live steam for from ten to fifteen minutes.

Cooperative work with the Bureau of Plant Industry looking to the control of cotton and cowpea wilt and root knot is being continued, and a large area in Dixie-Triumph, a new and improved strain of wilt-resistant cotton, is being grown at the Pee Dee Station for the purpose of producing seed of this valuable new production for distribution among farmers.

CHEMISTRY DIVISION

Owing to the great demand for chemists in war work, we were unable to fill the position of chemist immediately after Professor Keitt left us on September 1st, 1918, to take up chemical warfare work. Fortunately, however, the majority of the projects under way in this division were completed or of such a nature that they could be discontinued without loss. Soon after the signing of the armistice, we succeeded in securing the services of Dr. G. F. Lipscomb as chemist. He was discharged from the army early in January and reported for duty with us on January 10th, 1919.

Dr. Lipscomb has developed a new method for determining moisture in soils and agricultural materials, which enables

him to determine the nature of the decomposition products given off during the process. The method consists of heating the sample in a vacuum, collecting and analyzing the products given off. This method has been used very successfully by Dr. Lipscomb in reducing the moisture content of cotton seed, thereby destroying such seed-borne diseases as Anthracnose, Angular Leaf Spot, etc. A paper on this method is ready for publication.

Dr. Lipscomb has worked out a method and devised apparatus for determining moisture content, oxidation, and nitrification in soils and is cooperating with Professor C .P. Blackwell in the research project to study the effect of stirring soils on moisture content, oxidation, nitrification, and crop yields. He is also doing the chemical work on the project to determine the influence of different factors on the oil content of cotton seed. Dr. Lipscomb has developed a short and accurate method for determining borax in complete fertilizers, and has analyzed about seventy-five samples of fertilizer for borax for farmers. He has also developed a method for the determination of sulphur in pyrite by the reduction of iron with collodial metals. A report on this is ready for publication.

DAIRY DIVISION

The Dairy Division has continued the work of building up a high-class purebred herd. Several high-class Jersey heifer calves and one Jersey bull, from one of the most productive strains of the breed, have been added to the herd. During the past two years practically all of the old and unprofitable cows in the herd have been weeded out and their places taken by young and more productive individuals. During the year four Jerseys and three Holsteins have qualified for register of merit and advanced registry records. These records range from 450 to 530 pounds of butterfat.

This division is continuing experiments to determine the most economical concentrates to supplement cottonseed meal in a ration for dairy cows in the South, and to determine the relative value of corn silage and sorghum silage for milk pro-

duction. So far corn silage and sorghum silage seem to be of about equal value for feeding dairy cows.

The study to determine the cost of raising dairy calves is making satisfactory progress. Data are now being kept on twenty-four calves in connection with this experiment.

This division is conducting the following studies on the breeding of dairy cattle: (1) A study of the prepotency of the bulls used on the Experiment Station herd; (2) a comparison of line-breeding and out-crossing as systems of breeding dairy cattle; (3) line-breeding of Holsteins. The last two of these are being conducted in cooperation with the Dairy Division of the Bureau of Animal Industry of the United States Department of Agriculture.

ENTOMOLOGY DIVISION

This division has continued to study the effect of temperature-moisture on insect activity. This is a big problem but some phases of the investigation are now well under way. Among the most important are the following: (a) A study of the correlation between weather conditions and insect outbreaks; (b) a study of the direct influence of temperature-moisture on insect activity; (c) a study of the maximum temperature which the insect can stand under different conditions of humidity; and (d) a study of the conditions under which insects enter hibernation and under which they hibernate most successfully. Additional equipment has been procured for this project during the year. The data obtained during the progress of this project are being used in forecasting outbreaks of some of our destructive insect pests and in devising control measures for combating others.

This division has paid particular attention during the year to the development of bee-keeping in this State. It has been found that packing the colonies in such a manner as to protect them against the sudden changes in temperature has resulted in their coming through the winter in much stronger condition and prepared for the principal honey flow, which begins about May first. This has resulted in more than doubling the production of individual colonies.

The unusually rapid advance of the boll weevil has made it necessary for Prof. Conradi to give very close supervision to the quarantine regulations governing the movement of cotton seed and other quarantined articles from boll weevil infested into boll weevil free territory. The weevil has now reached Anderson, Laurens, and Chesterfield. The entomologist is cooperating very closely with the county agents and extension specialists in an effort to meet the boll weevil situations. Fortunately his experience with the weevil in Texas and this season in the southern part of the State enables him to forecast with some degree of accuracy what parts of the State will be most liable to sustain severe injury from this pest next year.

HORTICULTURAL DIVISION

The major research problem in the Horticultural Division is the study of the factors which influence seed and tuber production in Irish potatoes. Progeny of some of the 19,000 seedlings started last year are now in the third generation, and 81 of the most promising strains have been selected for further experimentation. Observations during the year indicate that drought and high temperature are unfavorable to seed production, and that cross-breeding proves more successful if conducted with the fall crop. About fifty standard named varieties of potatoes were planted in order to select varieties suitable for crossing with the Lookout Mountain variety.

This division has continued to conduct variety tests with vegetables and melons, and has tried out a few new vegetables imported by the United States Department of Agriculture. The Chinese rice bean appears to offer advantages as a vegetable, and as a forage and cover crop.

Sweet potato variety and fertilizer tests were conducted, and the sweet potato storage house, which was constructed by the college last year, has been renovated and somewhat modified, and is being used for storing experimental lots of potatoes.

This division is also conducting experiments relative to the utilization of the muscadine grape for the purpose of making unfermented grape juice, flavoring syrup, and other products.

COAST EXPERIMENT STATION

The work at the Coast Station at Drainland has been interrupted during the year by a number of circumstances over which we had no control. In the first place, the former superintendent, Mr. W. D. Garrison, was away from the station during July, August, and the first half of September, 1918, and soon after he returned he contracted influenza and died on the 18th of October. Mr. Garrison had been at the station as superintendent for about ten years and had very intimate knowledge of all of the work. His death, together with the general demoralized condition of everything at this time on account of the influenza epidemic and the scarcity of labor, made it impossible to get the experimental plot work harvested properly; so no results were obtained from the fertilizer and variety tests for this season.

Mr. J. A. Riley was appointed superintendent to succeed Mr. Garrison, and reported for duty on January 1, 1919. Labor conditions have continued to interfere seriously with the operation of this station. This has been particularly true of the experimental work. It has frequently been impossible to secure labor to plant and cultivate the experimental plots at the proper time. Excessive rains during the entire season of 1919 completely ruined practically all of the experiments with field crops at this station. During the early part of the season it was impossible to get the crop cultivated on account of the shortage of labor and the excessive rains, and later in the season the rains were so heavy and so frequent that the outlets for our drainage system were entirely inadequate for handling the water. On this account water stood on the crops, and they were so badly damaged in spots that no uniform results could be secured.

We have continued to add to our small beef cattle herd at this station until we now have fifteen cows and calves, and a

purebred Angus bull. This bull was given to us by the Buckfield Stock Farm at Yemassee, S. C. Two small pastures, six acres and twelve acres in area, were fenced out of the main pasture and experiments started to test the carrying capacity of the cut-over pine lands. Carpet grass and bermuda grass are already growing in the lots around the barns at this station, and carpet grass is beginning to appear in some of the closely grazed areas of the pasture. We expect to seed parts of the pasture to these plants duirng the coming winter and spring.

There is urgent need for some extensive experiments with pastures and beef cattle on the typical cut-over pine lands of the coast region. With the advent of the boll weevil it seems that the agriculture of this region will have to be changed, and there are thousands of acres of cut-over pine lands that should be made to produce something. The natural vegetation that is going to waste every year on this land would support large herds of cattle. Improved lespedeza and carpet grass pastures would support still larger herds. It seems to me that the development of a large beef cattle project at the station is the most urgent experimental problem we have before us. It is hoped that the Legislature will provide funds for this purpose.

PEE DEE EXPERIMENT STATION

The work at the Pee Dee Station has progressed satisfactorily during the year. The general crop conditions have been good except for tobacco, which was almost a complete failure in this community this season. The labor situation has continued to be very critical, but our efficient superintendent, Mr. R. E. Currin, has so far been able to retain sufficient labor to keep the experimental work going.

The horticultural work has continued to give us valuable data as to the best varieties of peaches, plums, grapes and strawberries. These fruits all do well in this section of the State. Our work indicates that it is necessary to spray grapes three times with Bordeaux mixture during the season in order

to keep the fruit free from disease. Tests have been made during the past two years of shipping grapes to various points, and the results show that the Delaware, Brighton, Moore's Early, Concord, and Niagara will stand transportation well. When properly packed they remain in the baskets four days in perfect condition, provided they are not mutilated in transit.

Asparagus and onions seem to be well adapted to this section of the State and have proved to be profitable crops.

Breeding work with the resistant cottons is being continued at this station, and very satisfactory results have been obtained. Several new and superior strains have been developed here in cooperation with Mr. L. O. Watson, of the Bureau of Plant Industry. One of these in particular, the Dixie Triumph, is proving to be both earlier and more productive than any of the other wilt-resistant strains. We will have a quantity of seed of this strain for distribution in 1920.

We are still devoting special attention at this station to soil fertility problems. In addition to the general comparative tests with fertilizers, as mentioned under the Agronomy Division, we are conducting fertilizer tests with peanuts, tobacco, and sweet potatoes, and have comparative tests of the different sources of nitrogen and potash. Trona potash is included with the other sources of potash, and we hope to have some results on the value of this material by the end of the season. The test of the different sources of nitrogen includes forms such as cyanamid and several of the other sources manufactured by the government nitrate plants. This test is in cooperation with the United States Department of Agriculture, as are also the tests with peanuts and with tobacco.

Breeding work has been undertaken with sweet potatoes in an effort to produce pure and superior strains of some of our standard varieties by hill selection. We have converted one of our tobacco barns into a sweet potato house and are trying out this plan of keeping potatoes this year. We feel that if this method works satisfactorily it will aid to a large extent in providing storage for sweet potatoes grown in this section of the State, where tobacco is one of the main crops.

The experiments with hog crops made satisfactory progress

during the year. We have included in the tests this year a number of half-acre plots of peanuts of the different standard varieties and these have been hogged off. Alfalfa, crimson clover, corn, peanuts, soy beans, and rape continue to be our most profitable crops for hogs.

We are also conducting culture tests here with cotton and with corn. The tests with corn include comparison of the Williamson plan with other methods of culture. The cotton tests include different methods of planting and cultivating cotton, as well as experiments testing the result of different distances and time of thinning. We are getting data from these tests which we believe will aid in increasing the earliness of cotton.

The work at this station has always attracted a great deal of attention from the farmers in the immediate vicinity of Florence, but, during the past few years especially, the experiments have attracted such wide attention that groups of farmers have been coming in from adjoining counties to spend a day from time to time at the experiment station. When I was at the station in July I met eighty-five farmers who came there from Sumter County to spend a day in looking over the experimental work on the station. Later, similar parties came from Lee county, Dillon County and Darlington County. I feel that in this way the work of this station is reaching a large percentage of the farmers in this section of the State, and I know of no other single agency that is doing as much to introduce improved practices in agriculture as the sub-stations.

PUBLICATIONS AND LIBRARY

During the year three regular bulletins of the Experiment Station series, totalling over 16,000 copies, were issued. The numbers and titls of these are given in the report of the Agricultural Editor, which is a part of this report.

The members of the experiment station staff have as usual prepared extension bulletins and news articles giving results of their work in popular form for the public. These have been sent out by the Agricultural Editor.

At the beginning of the fiscal year an up-to-date addressing outfit including a motor driven Graphotype machine, for cutting name plates, and a motor driven Addressograph machine, for addressing purposes, were installed in the mailing room. This equipment provides fo reasy, rapid, and efficient handling of the publications as issued.

During the year a good start was made towards the development of an agricultural library suitable for the use of our research workers and agricultural students. All of the books and pamphlets owned by the Experiment Station have been brought together and are being arranged and catalogued, and every effort is being made to secure complete sets of all state experiment station and United States Government bulletins. We now have over 20,000 books and pamphlets in the library.

STATE SUPPORT FOR RESEARCH

There are several important projects that should be undertaken just as soon as possible by the Experiment Station and these are of sufficient size and importance, it seems to me, to justify us in asking for support from the Legislature. The results of agricultural research are being appreciated and utilized by the other agricultural agencies and by farmers themselves now s never before. If our agriculture is to continue to develop along safe and sound lines it seems to me that it is absolutely necessary that the research agencies be developed to such an extent that they can point the way along all lines. If we are to do this we must have very greatly increased facilities. Practically all of the state experiment stations in this country are now securing annual appropriations from their Legislatures for research work. South Carolina has never asked for this. But the increased cost of experimentation has placed us in a position now where we cannot make satisfactory progress without additional funds. Since we are an agricultural state, it seems perfectly proper for public funds to be used for this purpose. The policy of our government, as stated in a report recently prepared by officers of the States

Relations Service, is to ask additional federal support for research work only after the several states have made appropriations in excess of the total of the Hatch and Adams funds, which we are now getting. If this policy is adhered to, it means that the only possible way to develop agricultural research in the several states is by state appropriations. There are two projects to which our Board of Trustees are already committed that seem to me of such fundamental importance at this time that we should make every effort to secure appropriations to carry them out. These are the proposed establishment of a Sand Hill sub-station and the beef cattle project for the Coast Experiment Station.

SAND HILL EXPERIMENT STATION

There are a number of reasons for asking for the establishment of a Sand Hill sub-station. In the first place, a station established in the Sand Hills would represent a soil type that covers a large area in this State. So far we have conducted no experimental work on soils of this type and, of course, at present have no facilities for doing such work. The conditions in the Sand Hills are so entirely different from what they are at our other stations that it is hard for us to make recommendations for farming operations that are at all satisfactory for this section. There are some fundamental research problems that could be conducted at a Sand Hill station that we have not been able to make progress with at the other stations. Here we would have almost pure cultures of sand to work with and could undertake research work with soil problems that cannot be conducted on any other kind of soil. There are many crops that seem to do well in the Sand Hills that are not considered particularly profitable in other sections of the state. Such a sub-station would give us facilities for breeding and growing these crops and for developing them for the use of the poorer portions of our state. The boll weevil situation, as it faces us at present, could probably better be worked out under conditions such as we would have at a Sand Hill station than at any other place, because conditions can be con-

trolled there better than on many tpyes of soil that are represented at our other stations. It seems to me that there is no other single thing that will add as much to our facilities for serving the entire state as the establishment of such a station.

BEEF CATTLE WORK

With the advent of the boll weevil, beef cattle are assuming a much larger place in our agriculture. What work this Station has been able to do along this line has been conducted at Clemson College under conditions which are probably not suitable for large developments along this line. It seems to me that if any section of South Carolina is suited to beef cattle production it must be the Coastal Plain section, where we have large areas of cut-over pine lands which produce an abundance of vegetation that now goes to waste. I believe that we could profitably utilize this land in the production of beef cattle. In order to conduct tests and make demonstrations along this line, and in order to conduct experiments relative to methods of grazing and production of satisfactory pastures, I feel that it is necessary for us to have a large tract of land and some equipment for handling beef cattle. There is available adjoining our Coast Experiment Station a suitable tract of land for such a project. This could be purchased if the Legislature would provide sufficient funds. I feel that this is one of the biggest problems that we have to face in the South today and am very anxious that facilities be provided for it.

Respectfully submitted,

H. W. BARRE,

Director.

THE SOUTH CAROLINA EXPERIMENT STATION IN ACCOUNT WITH U. S. APPROPRIATIONS

1918-1919.

DR.		Hatch Fund	Adams Fund
To balance from appropriations for 1917-1918			
Receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1919, under acts of Congress approved March 2, 1887, (Hatch Fund) and March 16, 1906, (Adams Fund)		$ 15,000.00	$ 15,000.00
CR.	Abstract		
By Salaries	1	$ 6,400.35	$ 10,292.88
Labor	2	3,416.72	1,909.45
Publications	3	622.21	
Postage and stationery	4	587.12	40.31
Freight and express	5	145.31	31.20
Heat, light, water, power	6	86.07	261.82
Chemicals and lab'y sup.	7		596.96
Seeds, plants, sundry sup.	8	410.77	283.72
Fertilizers	9	886.84	252.89
Feeding stuffs	10	1,190.75	
Library	11	100.97	39.20
Tools, machinery, and app.	12	268.80	33.74
Furniture and fixtures	13	389.13	152.72
Scientific appar. and spec.	14	142.13	968.77
Live stock	15		
Traveling expenses	16	251.85	62.12
Contingent expenses	17	20.00	
Buildings and land	18	80.98	74.21
Balance			
Total		$ 15,000.00	$ 15,000.00

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Treasurer of the South Carolina Agricultural Experiment Station for the fiscal year ended June 30, 1919; that we have found the same well kept and classified as above; that the balance brought forward from the preceding year was $ 000 on the Hatch Fund and $ 000 on the Adams Fund; that the receipts for the year from the Treasurer of the United States were $15,000.00 under the act of Congress of March 2, 1887, and $15,000.00 under the act of March 16, 1906, and the corresponding disbursements $15,000.00 and$15,000.00, for all of which proper vouchers are on file and have been by us examined and found correct, leaving balances of $ 000 and $ 000.

And we further certify that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, and March 16, 1906, and in accordance with the terms of said acts, respectively.

Attest: Signed:

S. W. EVANS, M. L. DONALDSON,

Custodian. For Finance Committee, Auditors.

SOUTH-CAROLINA AGRICULTURAL EXPERIMENT STATION—(Including the Sub-Station) 1918-19.

(SUPPLEMENTARY STATEMENT)

This supplementary statement, while not required by law, is desired as an aid in interpreting the account rendered for the United States appropriation. While it will be more useful if made in conformity with the schedule fixed for that appropriation, if this is not practicable, such a summary of receipt and expenditures from the sources indicated below as can be conveniently prepared from the books of the Station may be substituted. Whenever practicable it should be for the fiscal year ended June 30.

DR.

To balance on hand	$ 1,009.41
Receipts from other sources than the United States for the year ended	24,555.67
Total	$25,565.08

CR.

By Salaries	$ 3,677.63
Labor	5,539.39
Publications	306.00
Postage and stationery	15.28
Freight and express	158.23
Heat, light, water and power	691.04
Chemicals and laboratory supplies	9.44
Seeds, plants, and sundry supplies	1,873.03
Fertilizers	3,154.98
Feeding stuffs	1,837.66
Library	1,185.62
Tools, machinery, and appliances	33.15
Furniture and fixtures	107.40
Scientific apparatus and specimens	91.87
Live stock	603.65
Traveling expenses	938.64
Buildings and land	1,484.63
Balance	3,857.44
Total	$25,565.08

Report of The Division of Agronomy

The work of the Agronomy Division has been greatly handicapped by the shortage of help. Labor has been scarce and it has been impossible to conduct many of our projects satisfactorily. In the main station our assistant foreman resigned in the fall of 1918. We were unable to fill his place and the result was that many projects could not be started on time in the spring. This has made many of our projects of little value this year. At the July meeting of the Board of Trustees a new position of Assistant Agronomist was created. Mr. T. S. Buie was secured to fill this place temporarily and worked from August 18th to October 7th, 1919. Mr. W. B. Rogers of the class of 1919 at Clemson College has been appointed to fill this place permanently and started his work October 8th, 1919. Mr. Buie and Mr. Rogers have collected some valuable data this fall, and we hope that much better progress will be made with our experimental work in the future. All of the Station work in agronomy has been outlined as projects, and we now have thirty-two projects outlined and in process of investigation.

Adams Projects

Project No. 6. This project on Inheritance of Barrenness in Corn has been continued as planned, but the counts have not been made for this year, and there is no further data to report at this time.

Project No. 18. This project was dropped during the war but has now been revised by the Experiment Station Chemist and the Division of Agronomy cooperatively. We are making an effort to determine the factors affecting the oil content of cotton seed. The following factors are being considered this year.

1. **Variety.** Seed from the various varieties grown on the Experiment Station farms are being analyzed for oil content. We hope to find from this the difference in the several varieties grown in this state with reference to oil content.

2. **Fertilizer.** Seed from the various fertilizer plots at the main station and at the Florence station are being analyzed for oil content. We hope to get from this the effect of fertilizer on the oil content of seeds.

3. **Soils.** We are analyzing seed from a single pure strain of cotton when grown on different soils in the same locality.

4. **Climate.** We expect to analyze seed from the same soil type when grown in different parts of the state.

Project No. 24. This project is a study of inheritance in oats and has been continued as planned. The F_1 plants were grown in the greenhouse on the campus last spring. Much trouble was experienced with mice and English sparrows, but about sixty F_1 plants matured seed. F_2 plants will be grown this year.

Project No. 26. This project is conducted in cooperation with the Experiment Station Chemist and is planned to study the effects of stirring a soil on the moisture content, oxidation, nitrification, and crop yield. A heavy rain the latter part of June destroyed the stand of cotton on these plots and it was necessary to replant. This was done July 2. The cotton was left thick in the rows and has matured a crop even after this extremely late start. The soil has been analyzed for moisture and nitrate at regular intervals throughout the season. Not enough data has been secured as yet to be of any significance.

Hatch Projects

Project No. 1. Cotton variety tests are being conducted at the main station and at each of the sub-stations. The results this year were rendered of no value at the Coast Land Station by the excessive rains which destroyed the stand. The plan of conducting this test at the main station has been modified so as to give much greater accuracy and at the same time less trouble to execute. This was accomplished by making the plots long and narrow instead of short and broad as formerly done. Each variety is also replicated five to eight times.

In the 1918 test at Clemson College the highest yield was made by Alabama Cook No. 1010, which averaged 1890 pounds

of seed cotton per acre. The lowest yield was made by King-Triumph, which averaged 610 pounds of seed cotton per acre. The difference here between the best variety and the poorest is 1280 pounds of seed cotton, which was worth about $150.00. At the Pee Dee Station the best yield was made by the Wannamaker's Cleveland Big Boll, which averaged 2260 pounds of seed cotton per acre. The lowest yield of short staple was made by Drake's Dixie, which made 1520 pounds of seed cotton per acre. This is a difference of 740 pounds of seed cotton, worth about $80.00 at the time.

From these figures it is easy to see the immense significance of this test to the farmers of this state.

Project No. 2. Wheat variety tests are being conducted at the main station and at Florence. None of the varieties have made very large yields. Best yields were made by Fulcaster (18.3 bu.) Leap's Prolific, Golden Chaff, and Deitz Mediterranean.

Project No. 3. Cowpea variety tests are conducted at the main station. The results of these tests are not very satisfactory.

Project No. 4. Oat variety tests are being conducted at the main station and at Florence. The best yielding varieties have been Appler and Fulghum.

Project No. 5. Corn variety tests are being conducted at the main station. The best varieties for 1918 were Douthit, Garric, and Weekly. The yield of Douthit was 36 bu. at Clemson College and 60 bu. at Florence.

Project No. 7. This is a comparative test of grasses and forage crops. It is being conducted at the main station and at the Coast Station. The results have been unsatisfactory this year.

Project No. 8. This is a soybean variety test and is conducted at the main station. It has been satisfactory and has made satisfactory progress.

Project No. 9. This is a variety test of peanuts which is being conducted at the main station. There are no results on it this year.

Project No. 10. This is a variety test of velvet beans and is conducted at the main station. The results have not been satisfactory this year.

Project No. 13. This is a study of the effect of companion cropping of corn with legumes. This is conducted at the main station this year for the first time. The crop has not been harvested; therefore no results can be given. We hope to find out from this test what effect soybeans, cowpeas and velvet beans have on the yield of corn when grown with it as a companion crop.

Project. No. 14. This is a general comparative fertilizer test at the main station. This test has been running continuously in cotton for 14 years. There are 45 plots in all, and many different combinations of fertilizers have been used. The most striking lessons taught by this test are: first, that a complete fertilizer is necessary on this soil for best results; second, that it is becoming more and more difficult to secure a stand of cotton on the plots which have not been properly fertilized; third, that diseases are much worse in the cotton which is not fertilized with a well balanced fertilizer.

Project No. 15. This is a comparative test of phosphate fertilizer and is being conducted at the main station. The test is a comparison of 16 per cent acid phosphate, Florida soft phosphate, and Tennessee hard rock. Every fourth plot is a check, and each treatment is replicated four times for corn and four times for cowpeas. Another series of 16 plots will be added for cotton next spring.

Projects Nos. 19, 20 *and* 21. These are comparative tests of nitrogenous fertilizers. Number 19 is conducted at the Pee Dee Station and is the most extensive of the lot. Number 20 is conducted at the main station, and Number 21 at the Coast Station. These tests were started this year and there are no data available yet.

COLLEGE PROJECT.

Project No. 11. This is a culture test of cotton. It is conducted at the main station and at the Pee Dee Station. It is a comparison of various methods of spacing cotton with a view to determining the effect of spacing on earliness and yields. It also compares the time and method of thinning cotton on the yield and earliness.

Project No. 12. This is a culture test with corn. It is conducted at the Pee Dee Station and is a study of various methods of planting, cultivating and spacing of corn. This project is giving some interesting results.

Project No. 16. This is a general comparative fertilizer test at the Pee Dee Station. It includes 180 tenth-acre plots divided into four series. Series A, B, and C are in a three-year rotation of corn with cowpeas in middle, cotton, and oats followed by cowpeas. The cowpeas after the oats are harvested for hay. This year completes the second rotation and we now plan to report the results of this experiment in a separate publication as soon as the crops are harvested and the data compiled. It is showing some very interesting results.

Project No. 17. This is general comparative fertilizer test at the Coast Station. The results of this project have been lost for each of the last two years, because of excessive wet weather.

Project No. 22. This is a breeding project with Cleveland Big Boll cotton at the main station. It is progressing satisfactorily to date.

Project No. 23. This consists of plant-to-row selection work with some of our best varieties of wheat.

Project. No. 25. This consists of breeding work with barley. We have secured a strain of barley which is entirely beardless. It seems also to be a high yielder.

Projects Nos. 27, 28, *and* 29. These are ear-to-row breeding tests with Belmont, Lee County, and Lowman Yellow corn

varieties, respectively. This work was almost lost this year because of the shortage of labor at a critical time. We expect it to make satisfactory progress in the future.

Project No. 30. This consists of breeding work with Abruzzi rye. We believe we have secured a strain of Abruzzi rye which will outyield the ordinary strain by several bushels per acre.

Project No. 31. This is a breeding project with Cook cotton. We are attempting to get a high yielding strain of Cook cotton which is free from anthracnose. If this can be done we will have a variety which will undoubtedly be a superior variety of cotton.

Project. No. 32. This is a study of the effects of Trona potash and borax on crops when applied to the soil in different amounts and in different combinations with other fertilizers. We have a field test at the Pee Dee Station and also an extensive test in pot cultures in the greenhouse at Clemson College. The greenhouse work we expect to continue throughout the winter.

This year has been a very difficult one for our work, due partly to the erratic season and partly to the very great lack of funds with which to conduct the work. We feel that, considering the circumstances under which we have labored, our work has made reasonable progress but not satisfactory progress. All kinds of research work require two or three times as much money now as before the war, but we have no more money to work with now than we had ten years ago. The result is inevitable. The standard of the work cannot keep pace with that of other states, where more generous appropriations are made. We can see no way by which we can maintain even a modest standard unless we can get more money. Next year we must either have more money or abandon many of the projects which we now have going. The work is already far behind what it ought to be and we regret to see it drop back further. Some states are investing ten times as much money

in research work as South Carolina. Can the State of South Carolina hope to have her agricultural problems solved with one-tenth the money that other states are paying? Can we hope to keep abreast of the times agriculturally unless these problems are solved?

Respectfully submitted,

C. P. BLACKWELL,

Chief of Division.

To Director H. W. Barre.

Report of The Division of Botany

The work of the Division of Botany and Plant Pathology has been continued along the lines reported last year. The changes in personnel, which were caused by the Associate Botanist and three of the assistants in this Division going into the army, interfered to some extent with the research work of this Division.

Mr. R. C. Faulwetter, Associate Botanist in charge of several lines of pathological research, was on leave during the war and resigned before time for him to return and resume his work. Mr. Guy West Wilson, who held this position temporarily, had already accepted work elsewhere when Mr. Faulwetter's resignation was received; so a new man had to be elected for this position.

Miss Ellen Converse, Assistant in Botany, resigned June 1st after having spent one year in the research laboratory. The increased cost of supplies, equipment and labor has so depleted our funds for research that we felt it necessary to discontinue the position vacated by Miss Converse and go back to the plan of having graduate assistants help with the investigation work. Mr. M. L. McHugh, a Clemson graduate of the class of 1919, was appointed to the position of graduate assistant beginning July 1st.

A summary of the work on the different projects is given below:

Cotton Anthracnose

Owing to the press of other work and lack of suitable equipment, we had made little progress during the previous two years in the study of the influence of different factors on the vitality of the anthracnose fungus. Mr. Wilson began work on this phase of the project when he reported for duty last fall, and first checked over the previous work done with seed of different ages. When Dr. G. F. Lipscomb returned from

war service and entered upon his duties as Chemist of the Experiment Station, we secured his cooperation in this project, and he constructed apparatus which he used in removing the moisture from seed by placing them under a vacuum. The moisture content was in this way reduced quite rapidly, and by continuing the operation, all of the moisture could be removed from the seed. It was found that the moisture content of the seed is an important factor in the vitality of the fungus. In infected seed in which the moisture content had been reduced from 9 per cent to about 2 per cent, all of the fungus was killed. These seed germinated just as well as, and in some cases better than, the untreated seed.

Different combinations of heat and dessication were also tried with different lots of seed, and it was found that the fungus is killed more readily by a combination of heating and drying than by dessication alone. In order to test out the feasibility of commercializing this principle and utilizing it as a control for anthracnose and other seed-borne diseases on a large scale, we arranged for an experimental drier to be made which would dry the seed by passing a current of dry hot air over them. This drier was arranged for in January but was not shipped until June 22nd and arrived here five months later; so we have not yet had opportunity to test it. In the meantime, Dr. Lipscomb has been checking over his preliminary work and testing out different combinations of heat and dissication with a view of utilizing the data accumulated in this way in planning a vacuum dessicator, which would be practical on a commercial scale. This phase of the project will be pushed as rapidly as our facilities will permit, and we are very hopeful of getting results which will be of value in furnishing additional control measures for this troublesome disease.

The work on the virulence of the different strains of anthracnose was continued by Miss Converse, and strains of the organism were isolated from material sent in from Alabama, Mississippi, and Louisiana, and from a number of localities in this State. Some differences were observed as to the behavior of the different strains in culture, but the work was so se-

riously handicapped by a number of occurrences over which we had no control that little was accomplished. Our plan was to have Mr. Faulwetter spend sometime in other states studying the disease in the field and collecting material for further experiments here. On account of shortage of funds, the Office of Cotton and Truck Diseases of the United States Department of Agriculture has withdrawn its cooperation and support for this work, and this deprives us of the means of carrying the work into the states south of us.

During the summer of 1918, Miss Converse found a species of Colletotrichum growing in the nectar glands of cotton leaves, and we undertook to determine how common this occurrence is and whether or not this is the same strain of Colletotrichum that causes anthracnose. It was found that wherever anthracnose was present in the field, the fungus was present in the nectar gland of some of the leaves. Examinations made in one field where anthracnose was very prevalent brought out the fact that 90 per cent of the nectar glands on diseased stalks were infected with this fungus. Inoculations made with this strain of Colletotrichum proved it to be capable of producing anthracnose and led us to conclude that the nectar gland of the leaf is a place where the anthracnose fungus is able to live over during the summer and might be an important source of inoculation for the bolls after they begin to develop.

Angular Leaf Spot of Cotton

The experiments looking to the control of this disease by delinting the seed with sulphuric acid were followed to their conclusion at the end of the season. The results of this test, together with a complete report of this investigation, were published in bulletin No. 198 of this station. This investigation had continued for three years and we were fortunate in having it practically completed and a satisfactory control method worked out before Mr. Faulwetter gave up the work to enter the army.

Bacterial Content in Milk

During the summer of 1918 Mr. W. B. Aull, of this Division began a study of the bacterial content of milk with a view of determining the behavior and development of bacteria during the different periods of handling milk from the time it is milked until it reaches the consumer. It seemed that no very thorough studies had been made along this line in the South and the project was undertaken with the view of determining practices and methods of handling milk which would keep down the bacterial content. No definite conclusions have been reached at this time, but we have gone far enough with the project to find that some of our practices of cleaning and sterilizing cans and other containers have been at fault. The work indicates that cans and containers are important sources of bacteria commonly found in milk. Milk drawn directly into sterile flasks and kept at room temperature during the summer has kept sweet for from 36 to 48 hours, while milk placed in buckets and cans which had been well washed and appeared to be thoroughly cleansed but had not been sterilized remained sweet for only from 10 to 15 hours. Mr. Aull has found that cans and buckets can be thoroughly sterilized by inverting them over a jet of live steam for one minute, but such pieces as can lids and separator parts can be sterilized thoroughly only when placed in a closed vat and exposed to live steam for from ten to fifteen minutes. The milk cooler is one of the hardest pieces of apparatus to sterilize and is frequently a prolific source of bacteria.

Plant Disease Survey

The plant disease survey, which we are conducting in cooperation with the Office of Plant Disease Survey of the United States Department of Agriculture, has been continued, and additional data accumulated relative to the prevalence of many of our common plant diseases. Special surveys have been made during the year with a view of finding whether or not certain dangerous diseases which have been recently

brought into this country are present in South Carolina. A very complete survey was made in an effort to determine whether or not the wart disease of Irish potato had been introduced into South Carolina. This disease was recently found in Pennsylvania and it was feared that it might be spread into other states, especially since some of the potatoes of the same lot which were supposed to have introduced the disease into Pennsylvania were shipped into several of the southern states, including three points in South Carolina. This survey failed to reveal the presence of this disease, and we feel sure now that it will not make its appearance in this state as a result of these shipments. We have been constantly on the lookout for other new diseases which have appeared in other sections of the United States and through our Extension Pathologist have cooperated very closely with the county agents in checking the common diseases which are prevalent.

Cooperative Research

The cotton and cowpea wilt and root knot work in cooperation with the Bureau of Plant Industry, looking to the control of these diseases, has been continued. The breeding work on this project was temporarily discontinued during the war on account of lack of sufficient assistance from the Bureau to continue the work. This will be taken up again this season, however, and it is hoped to push it to a satisfactory conclusion.

Breeding work for the improvement of the wilt-resistant varieties of cotton is being continued, and at our Pee Dee Station we have grown this year a large area in the Dixie Triumph hybrid, the most productive and one of the most promising of the new wilt-resistant strains developed by Mr. L. O. Watson in cooperation with this station.

The chief of this Division has continued to serve on the War Emergency Board of American Plant Pathologists. At the Christmas meeting of the American Association for the Advancement of Science and the Society of American Plant Pathologists the title of this board was changed to the Ad-

visory Board of American Plant Pathologists and the board was made permanent. This board consists of six pathologists representing the different sections of the country. I was elected for another year to serve as Commissioner for the South. In this capacity I called a meeting of the southern pathologists and horticulturists for a conference on sweet potatoes at Birmingham during the meeting of the Association of Southern Agricultural Workers the last three days in February. There were present at this conference forty-six persons representing thirteen states and the U. S. Department of Agriculture. The conference spent two full days discussing different phases of sweet potato production, storage, and marketing, and reached definite conclusions on many of these subjects, which have gone far towards clearing up a great many disputed points. A fifteen-page report of this conference was prepared during the sessions, and later distributed to all of the workers in the South and East. A steering committee (H. W. Barre, Chairman, Clemson College, S. C.,; G. C. Starcher, Auburn, Ala., and R. G. Hill, U. S. Department of Agriculture) was selected to correlate the research which is now under way on the different phases of the sweet potato problem and to initiate additional cooperative research in the different experiment stations and the U. S. Department of Agriculture. This committee met later and drew up five different projects, which are now in operation at practically all of the southern stations and in several offices of the U. S. Department of Agriculture. From such cooperative endeavor it is hoped to solve some of these important questions more economically and more rapidly than could be done by individual effort.

H. W. BARRE,
Botanist and Plant Pathologist.

Report of The Chemistry Division

The work of this Division was taken over by the writer upon his discharge from the Chemical Warfare Service of the U. S. Army on the 15th of January, 1919. The first month of the year was spent in taking inventory and moving into new quarters.

The following projects have been approved and are under way:

Project No. 25.

The study of the determination of moisture in soils and agricultural materials, and the nature of the decomposition products given off. Work on this problem has been progressing very satisfactorily, and very interesting results have been obtained. We first studied the determination of moisture in cottonseed meal, and we found the method that has been used gives very unsatisfactory results. In this method the sample is heated in a steam oven for five hours. The results obtained were from 0.5 per cent to 2 per cent low. A new method has been worked out and the apparatus perfected. The sample is heated in a vacuum containing tubes of Calcium Chloride. In this way the moisture can be removed in only a few minutes from most materials without the sample undergoing decomposition. A study of the moisture content of cottonseed meals has been completed by the new method, and we find that we can remove from 1 per cent to 2 per cent more moisture from the material than by the old method, without the least decomposition of the material. It is hoped to publish the first paper on this project in the near future.

Project No. 26.

A study of the effect of stirring the soil on moisture content, oxidation, nitrification and crop yields. This project is a joint problem of the Agronomy Division and this Division.

On account of the difficulty experienced in getting the cotton seed to come up in the spring, the problem was begun very late. The work is progressing very satisfactorily. The apparatus we designed and made seems to work very well. We have not obtained sufficient data so far upon which to draw any definite conclusions, but we hope by the end of the season to have sufficient data on this project upon which to draw definite conclusions.

Project No. 18.

A study to determine the influence of different soil types and different fertilizers on the chemical composition of certain plants, particularly in reference to the oil content of cotton seed. The problem is a joint problem with the Agronomy Division. Prof. Blackwell of that Division has collected the seed from different varieties of cotton, and we expect to begin work on this project at the beginning of another season.

Miscellaneous

Prof. Guy Wilson and myself, assisted by some of my students, have studied dessication as a method of control of seed-carried diseases of cotton. We have obtained very interesting results. In fact, we were not only able to remove all fungus diseases from the seed, but also to increase the percentages of the germination of the seed. We have one paper already completed, and probably enough data on hand for another article on this subject.

Because of the damage done the various crops this season by the presence of borax in certain American potash salts, it became necessary to find a short and accurate method for the determination of borax in complete fertilizers. A very accurate method for the determination of borax in complete fertilizer was worked out by the writer and Prof. C. F. Inman. Dr. R. N. Brackett will give a report of the work at the meeting of the Official Agricultural Chemists in Washington, November 19th and 20th, 1919.

A method for the determination of sulphur in Pyrites by the reduction of iron with collodial metals, has also been worked out by this Division and is ready to be published.

The Division has analyzed a great many soils and fertilizers from different parts of the State. There have also been about seventy-five samples of fertilizers sent in to be analyzed for borax.

We have cooperated with Prof. W. J. Young to remove the collodial material from grape juice. This problem was solved satisfactorily.

Respectfully submitted,

G. F. LIPSCOMB,

Chief of Division.

To Director H. W. Barre.

Report of The Dairy Division

Following is a report of the experimental work in progress in the Dairy Division:

HATCH PROJECTS

I. *Feeding dairy cattle.*

(1) A study to determine the most economical concentrate to supplement cottonseed meal as a feed for dairy cows in the South.

No further results have been obtained in this experiment since the last report. We had planned to continue this experiment comparing velvet bean meal and wheat bran as a supplement to cotton seed meal, and to use three groups of cows. On account of the fact that we have all of the available cows on official tests, it has been necessary to postpone the experiment until we have a sufficient number of grade Holsteins fresh to get three groups of five cows each for the experiment. This experiment is to be undertaken, and continued, in co-operation with the Alabama and North Carolina stations, where similar experiments will be conducted under identical conditions.

(2) A comparison of corn silage and sorghum silage for milk production.

This experiment was carried for one month, two groups of cows being selected as nearly as possible according to age, lactation period, size, and milk yield. The results obtained indicate very little difference in the value of the sorghum silage and corn silage. This experiment will be continued another year in order to check the results.

II. *To ascertain cost of raising dairy calves to two years of age.* For this experiment we are using registered Jersey and Holstein calves and grade Holsteins. The calves are weighed once each week and at the end of each month, and the height to withers is recorded. At the present time, we have 24 calves on which data are being kept. This experiment has now been under way eight months. In another year we should have some very valuable data.

III. *A study of the prepotency of the bulls used in the Experiment Station herd.* The records of the foundation cows, including grades, registered Holsteins, and registered Jerseys, are being compiled and comparisons made with the records of their progeny, sired by the herd bulls. This experiment should be continued indefinitely as it will give valuable information as to our breeding operations. The data which we have secured so far tend to show that some bulls have been used in the herd which lowered the average production of the herd.

IV. *A comparison of line-breeding and out-crossing as systems of breeding dairy cattle.* This project is being undertaken in co-operation with the breeding specialists of the Dairy Division of the U. S. Bureau of Animal Industry. Registered Jerseys will be used. After securing proved bulls, we expect to make comparisons of the conformation and production of their daughters, one group of which shall be line-bred and the other out-crossed.

V. *Line-breeding of Holsteins.* This project is being undertaken in cooperation with the breeding specialists of the Dairy Division of the U. S. Bureau of Animal Industry. This Division lent us a Holstein Bull, which we were so unfortunate as to lose with tuberculosis. As soon as the herd is again free of tuberculosis, we hope to secure the loan of another bull, and in cooperation with the U. S. Dairy Division Specialists, to continue this experiment, following the bull with one of his sons.

During the year we were unfortunate in having an outbreak of tuberculosis, as a result of which we had to slaughter one Jersey cow and twelve Jersey heifers, together with some young bulls and some grade Holsteins. This was a very serious loss, but we still have in the herd forty-six heifers, which we expect to raise to maturity and add to the herd.

During the year we have also disposed of a large number of older and undesirable cows from a standpoint of production, and now have a herd of registered Jeresys and registered Holsteins of splendid conformation and fairly good production. During the year four Jerseys and three Holsteins have qualified for Register of Merit and Advance Register records. These records range from 450 to 530 pounds of butterfat.

Respectfully,

W. W. FITZPATRICK,

Dairyman

To Director H. W. Barre.

Report of The Entomology Division

The following is a report of the Entomology Division of the South Carolina Experiment Station for the fiscal year ending June 30, 1919.

The work of this Division under Adams fund has been prosecuted along lines followed the previous year.

Project No. 1. Investigation of Strongyloid Parasites of the Intestinal Tract of Ruminants has been held in suspense awaiting facilities for prosecuting those features of the work which are still in doubt. The temporary suspension of this project was necessary because of conditions created by the war. The point in question in reference to this project is the real cause of the death of the animal. This question was very fully explained in the Twenty-Second Annual Report of the South Carolina Experiment Station with a umber of diagrams illustrating methods included in carrying on the work and the result secured.

Project No. 2. The Relation of Temperature-Moisture on Insect Activity has been the principal project under investigation in this Division during the past year. Since the beginning of this project, our greatest difficulty has been to provide apparatus with which the research might be conducted. Improvements have been made from year to year but it became very apparent during the past season's work that certain parts of our equipment would be required to work with greater accuracy than we were able to obtain heretofore. In compiling our records it was impossible to formulate certain conclusions because of the fallability of the cold storage chamber of our temperature-moisture plant. We have every reason to feel that this difficulty will be overcome through the installation of a refrigerator of ample size with the best insulation that is manufactured, as well as the installment of a refrigeration plant with which the low temperature can be controlled with great accuracy. In every other feature our apparatus is the same as during the previous year.

The opportunities presented by this problem are many, varied, and far-reaching. The same plan of procedure was followed as heretofore and for convenience the work is prosecuted under the following heads:

1st. The study of correlation between weather conditions and insect outbreaks. Charts covering a period of ten years are now available in this office, and the interpretations obtainable have important economic value in anticipating insect disturbances.

2nd. Direct influence of temperature-moisture on insect metamorphosis. This is prosecuted with our specially constructed apparatus, and the work so far shows not only the dynamic influence of the amount of temperature-moisture present but the influence of the relative amounts of each as well.

3rd. A study of maximum temperature to insect life, with the moisture percentage known. For this there is being used a specially constructed apparatus having a Feras Electric Oven as a basis for determining the effect of high temperature on insect protoplasm. For determining the temperature of individual insects we have installed an Electric Potentiometer. The temperature of an insect body varies, and the fatal effect of high temperature depends upon the maximum temperature attained by those organs which are most active. Protoplasm influenced by high temperature is much more serious to the life of the insect than the influence of cold. This is, furthermore, intended as rechecking of scientific records which were obtained without the consideration of relative humidity.

4th. A study of conditions under which insects enter hibernation and under which they hibernate most successfully. This is conducted principally by a process of systematic weights secured from the time when the insect has normal activity to the time it enters complete hibernation. This is repeated throughout the hibernation period and until the insect has laid eggs after leaving hibernation in the spring. This work directs attention to the great importance of humidity

in weather conditions during the fall and winter. Though we have formulated a number of theories, there are discrepancies in our evidence, and every effort is being made to determine these.

Project No. 15 has coalesced with Project No. 2, and we are not able to keep them separate. When the approval for the prosecution of this project was asked for, our Project No. 2 had not developed sufficiently to foresee that the fundamental principles involved in both projects were the same. Little progress has been made with this phase of the project since our report of the work in the last Annual Report, and this is due to the extremely long life history of the species. We believe, at this time, that the life history requires a period of five years.

Various minor problems were prosecuted under the Hatch Fund during the past year. Owing to the large amount of attention required by Adams work, and the many and various duties of the Division due to the very rapid development of entomological work, it was necessary to pick only important phases of this problem, since we were unable to handle the problem as a whole. Work was continued with the cottony cushion scale in establishing the lady bug permanently. It was our intention to have this problem worked out heretofore, but owing to the conditions of the times, it was delayed. The effect of the lady bug in controlling this scale in the southern part of the state has been demonstrated beyond any doubt, but unfortunately the lady bug dies out during the winter, and we believe that provision can be made to successfully hibernate.

Further experience with the Argentine ant indicates that the poison recommended for this purpose is entirely satisfactory, provided it is intelligently and systematically used.

Owing to the rapid development of bee-keeping in this state, it was necessary to determine: first, the fluctuation of the South Carolina honey flow; secondly, the best program to follow by which the hive could be properly strengthened for the season of maximum honey flow. The packing of last season

showed such marked advantage over unpacked colonies under similar conditions that the experiment will be repeated under much more exacting conditions than it was possible to do heretofore. It has been found to be one of the most important steps in providing for a powerful, roaring, boiling colony in time for the principal honey flow, which begins approximately May 1st throughout the state.

Special publications on this line of work are almost ready for the press, but owing to the many demands made on this Division during the past year, it was impossible to concentrate attention on these reports sufficiently to complete them. With the better facilities at hand we will be able to have these completed shortly.

The Station work as a whole in this Division has developed along fundamental lines and enables the Division to foresee more accurately and more intelligently insect disturbances not only from year to year but throughout the season as well. The value in this feature of the work is so apparent that our project pertaining to this work will be prosecuted with great energy. Proper and accurate advice, timely given, enables the farmer to pursue his plans most successfully and at the same time prevent much unnecessary loss that has been unavoidable heretofore.

Respectfully submitted,

A. F. CONRADI,

Chief of Entomology Division.

To Director H. W. Barre.

Report of the Horticultural Division

The following is a report of the Horticultural Division of the Experiment Station for the fiscal year ending June 30, 1919.

During the past year the orchards and vineyards have been enlarged to a considerable extent and many new varieties and types of fruits planted. This extension of the orchard and addition of new types will greatly facilitate the experimental work, which we have under way, the larger areas of standard varieties affording excellent opportunities for more extensive work in the controlling of insect and fungus diseases in connection with the divisions of Botany and Entomology. The older orchards were largely planted for variety tests and there were not enough trees of standard sorts to conduct experiments in an extensive way. The orchards now under way will afford excellent opportunities for conducting experiments to determine the best methods for cultivating, fertilizing, and spraying orchards in order that the best results may be obtained.

The following detailed statement of the experiments conducted in the past year is taken from the report of Assistant Horticulturist, W. J. Young.

Adams Project No. 21.

The work in Irish potato breeding has been continued along the same lines as in former years and some additional phases of the work have been taken up. The original lot of seedlings has been reduced by selection to 81 of the most promising. About two bushels of seed balls of the Lookout Mountain potato have been collected and the seed separated. The amount of seed obtained was more than sufficient to meet the needs of the department and steps have been taken to distribute the surplus among experimenters. About 1000 new seedlings have been grown to maturity in the greenhouse. The tubers ob-

tained were sprouted on sand under moss and planted in pots in the greenhouse for a fall crop.

The seeds of the Irish potato are small, amounting to about 800,000 to the pound. They germinate readily, even after several years' storage, and the young seedlings are easily handled, but need careful protection from the Colorado potato beetle. The seedlings begin tuber formation at a very early stage.

Observations during the present season indicate that drought and high temperature are unfavorable to seed production and that cross-breeding will probably prove more successful if carried on with the fall crop. Material has been collected for microscopic study of pollen and seed production. Selected tubers of Lookout Mountain from last season's crop have been planted by the tuber unit method and the remainder of the seed potatoes have been planted for hill selection. About 50 standard named varieties of potatoes have been planted in order to select varieties suitable for crossing with Lookout Mountain.

Hatch Experiments

Variety tests of vegetables were conducted on a small scale with melons and sweet potatoes, and a few new vegetables imported by the United States Department of Agriculture have been tested. The Chinese cabbage gives promise as a fall crop and the Chinese rice bean appears to offer advantages not only as a vegetable but also as a forage and cover crop.

An acre planted to sweet potatoes in 1-20 acre plots, which were given different amounts and kinds or fertilizers. In this way much light has been obtained on the fertilizer requirements of sweet potatoes on the soils of the Experiment Station. The sweet potato storage house has been thoroughly renovated and careful observations will be made of storage conditions and the behavior of the crop in storage.

The work with fruits has been systematized and placed more completely than formerly upon the project basis. The testing of tree, vine, and small fruits has been continued with the objects of finding varieties better adapted to conditions in the

state and of selecting forms for use in breeding. The variety plantings of the Station form a basis for this work, but these plantings contain some varieties which the tests have shown to be of little value and lack some of the standard sorts, as well as a number of new varieties of promise and several types of possible value in breeding. A study is being made to determine which may be dispensed with and what additions are desirable to bring the plantings up to date and make them most useful, and to find out where the desirable varieties may be secured. Such varieties are added from time to time as opportunity permits. A considerable number of imported plants were received from the United States Department of Agriculture in the spring and planted for testing. They include varieties of apple, pear, peach, jujube, and a number of miscellaneous fruits and economic plants. Several apple crosses were made in the spring but with very little success. The Concord grape was crossed by Lucile and a good set of fruit obtained. The seed will be kept stratified in sand until mid-winter, when they will be planted in the greenhouse.

A test of small fruits and a study of the transmission of characters in these fruits when grown from seed, with particular reference to determining the factors involved in the production of impaired varieties adapted to the southern states has been outlined and about 150 pure seedlings of the Haymaker raspberry have been grown. Further work along this line will require a variety plantation of small fruits, plans for which are now under way.

Owing to late frosts, the peach crop was a failure at the Station the present season. Other fruits also were injured, with the exception of the grape, which set a fair crop of fruit. Experiments on pruning and training of the grape were continued along the same line as in former seasons.

Owing to the enactment of prohibition and the resulting increase in the soft drink business, the grape is assuming increased importance as a source of unfermented grape juice, flavoring syrup, and other products. Much attention is now being given to the utilization of the grape and the preparation

of various grape products, particularly from the Muscadine grapes.

The protection of fruits from disease and insect pests is a preblem of increasing importance in the state, owing to the present active interest in fruit growing. Plans are now under way at the Station to meet this situation more effectively than in the past. A comparative test of different spraying materials has been outlined and will be carried out during the coming season. This work has received the hearty cooperation of the manufacturers of supplies of this class and it is anticipated that results will be obtained of considerable value to the fruit growers of the state.

Pee Dee Station Experiments

The horticultural work conducted at the Pee Dee Station at Florence has been very satisfactory. During the past season, we have obtained valuable notes on varieties of peaches and grapes. Our tests for a number of years, at this station, of standard varieties of grapes, peaches and plums show conclusively that these fruits can be grown to perfection in this section of the state.

Spraying experiments have been conducted with grapes and peaches and it seems necessary to apply from two to three sprays in order to have the fruits free from diseases and insects. There is no reason why peaches and grapes should not be grown extensively for commercial purposes in the central and eastern parts of the state.

A number of tests were made during the past two years of shipping grapes to various points in order to determine their shipping qualities. The results of these experiments show that the Delaware, Brighton, Moore's Early, Concord, and Niagara will stand transportation well. When properly packed they remain in the baskets for four days in perfect condition, provided they are not mutilated in transit.

Little work has been done with vegetables at the Pee Dee Station for the past few years. We contemplate continuing our experiments with asparagus, strawberries, and onions, as

these three crops appear to be exceptionally well adapted to this section of the state and, we believe, will prove very profitable when grown on an extensive scale.

Coast Station Experiments

The horticultural work at the Coast Experiment Station has been carried on as usual. Experiments with grapes and peaches show that where these fruits are given proper care and attention, they can be grown in the Coastal Plains with success. Our experiments also show that it is necessary to give the trees and vines reasonably good care, otherwise the results will be disappointing.

During the next season, it is hoped that we will be able to conduct more extensive experiments with truck crops. The Coast Station, situated as it is, in the trucking section of South Carolina, seems to be the logical place for conducting experiments with our principal truck crops, and it is to be hoped that during the coming season, fertilizer experiments with Irish potatoes, lettuce, cabbage, and sweet potatoes may be conducted at this station.

Respectfully submitted,

C. C. NEWMAN,

Chief of Horticultural Division.

Report of the Agricultural Editor's Division

The following is a report of the Experiment Station work conducted by the Agricutlural Editor's division for the fiscal year ending June 30, 1919.

A. Publications Issued

Bulletin 197. Analyses of Commercial Fertilizers (8000 copies).

Bulletin 198. Angular Lear Spot of Cotton (3500 copies).

Bulletin 199. The Cicadellidae or Leaf Hoppers of South Carolina (5000 copies).

Thirty-First Annual Report, Year Ending June 30, 1918. (1100 copies).

B. Mailing Room Progress

At the beginning of the fiscal year an up-to-date addressing outfit was installed, consisting of a motor-driven Graphotype machine for cutting name plates and a motor-driven Addressograph machine for addressing purposes, with the necessary accessories and supplies. This material, purchased jointly by the Experiment Station and the Extension Service, provides for the easy, rapid, and efficient handling of the publications as issued.

The four thousand classified names which had accumulated from the effort made the previous year to revise the mailing list were stenciled at once, and additions and changes have been made weekly since as needed.

C. South Carolina Experiment Station Library

In accordance with provision made to that end by the Board of Trustees, the Experiment Station library was placed under this division and a part of the museum hall was turned over

to the uses of the library. Necessary equipment to start the work was purchased, all books, Government publications and Station publications from the several states then on hand were collected from the mailing room and the various divisions, and work was begun in the classifying and cataloging of this material. The work was slow and unsatisfactory at first, because no regular librarian was provided; but with a librarian provided at the beginning of the present fiscal year, excellent progress is being made. It is our purpose to make this library a serviceable working library for the agricultural workers of the Experiment Station, the Extension Service, the Agricultural Department, and also for the agricultural students of the College.

D. Publicity Work

A considerable amount of the publicity material sent out by the Agricultural Editor in the Weekly News Notes, News Letters, and special articles to newspapers and agricultural publications is obtained from Experiment Station sources and deals with Station work. This material has either news value or instructional value or both, and seems to be doing much good. Publicity in regard to the bulletins of the Station has created a considerable demand for these publications from individuals not on the mailing list; and publicity regarding experiments and results obtained is helping more widely to give the people the benefits of the work of the Station. It is hoped that a still closer cooperation between the editor and the various workers will result in much more effective work along this line.

Respectfully submitted,

A. B. BRYAN,
Agricultural Editor

To Director H. W. Barre.
Nov. 26, 1919